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Notes on some *Catoptria* Hübner, 1825 (Crambidae, Lepidoptera) from the Central Apennines (Italy), with the descriptions of *Catoptria samnitica* sp. nov. and the male of *Catoptria apenninica* Bassi, 2017

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http://zoobank.org/BAFC6690-E8F0-4B69-9093-D50AC0A3CA65

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Abstract. Material collected in recent expeditions by staff of the Tiroler Landesmuseen, Innsbruck, allows an update of some high elevation *Catoptria* of the Central Italian Apennines. *Catoptria samnitica* **sp. nov.** and the male of *Catoptria apenninica* Bassi are described from morphology and DNA barcodes, and adults and genitalia are illustrated. Both species are considered as regional endemics of the Central Apennines.

Introduction

Catoptria Hübner, 1825 is a large Holarctic genus of Crambinae with 85 described species, of which 81 are Palearctic, two Holarctic and two Nearctic (Nuss et al. 2020). The *C. permutatella* species group sensu Błeszyński (1957) and Bassi (2017) is one of the largest of the genus, with 27 known species, including the Nearctic *C. latiradiellus* (Walker, 1863). It has a strong tendency to small-scaled, regional endemism in montane and subalpine environments. Italy is a diversity hotspot for the species group in Europe, with 10 known species, of which four are endemic to parts of the country: *C. apenninica* Bassi, 2017 (Central Apennines), *C. orobiella* Huemer & Tarmann, 1993 (southern Central Alps), *C. spatulellus* (Turati, 1919) (Northern Apennines), and *C. spatulelloides* Błeszyński, 1965 (Southern Apennines). Intensive fieldwork carried out in 2010 and 2011 in Abruzzo and Lazio by Peter Huemer and Toni Mayr resulted in the collection of a series of *Catoptria* specimens, including a new species and both sexes of *Catoptria apenninica*, for which the male was previously unknown.

Material and methods

Genitalia preparations were made following Robinson (1976). The terminology of the genitalia follows Klots (1970) and Kristensen (2003). Genitalia photographs were taken with a Canon S120 digital camera. The habitus photographs were taken with a Nikon D300 digital camera. The images

were enhanced with Adobe Photoshop Elements. The length of the labial palpus is compared to the maximum diameter of the composite eye in side view.

Specimen repositories: RCGB = Research Collection of Graziano Bassi, Avigliana (Torino), Italy; RCTM = Research Collection of Toni Mayr, Feldkirch, Austria; TLMF = Tiroler Landesmuseum Ferdinandeum, Innsbruck, Austria.

DNA samples (dried legs) were prepared according to prescribed standards and submitted to the Canadian Centre for DNA Barcoding (CCDB, Biodiversity Institute of Ontario, University of Guelph) to obtain DNA barcodes, and using the standard high-throughput protocol described by deWaard et al. (2008). Sequences were submitted to GenBank, further details including complete voucher data and images can be accessed in the public dataset "DS-CATOITAL" https://www.doi.org/10.5883/DS-CATOITAL in the Barcode of Life Data Systems (BOLD; Ratnasingham and Hebert 2007). Degrees of intra- and interspecific variation of DNA barcode fragments were calculated under the Kimura 2 parameter model of nucleotide substitution using analytical tools of BOLD systems v. 4.0. (http:// www.boldsystems.org). A Neighbor-Joining tree of DNA barcode data of Italian taxa, with the exception of the currently not sequenced *C. orobiella*, was constructed using MEGA 6 (Tamura et al. 2013) under the Kimura 2 parameter model for nucleotide substitutions.

Identification success was furthermore assessed by the Barcode Index Number (BIN) system as implemented on BOLD (Ratnasingham and Hebert 2013). This system employs a two-stage algorithm that groups all sequences > 500 bp that meet defined quality criteria into Operational Taxonomic Units (OTUs) and automatically assigns new sequences to BINs, irrespective of their previous taxonomy and origin. Similarities or differences between BINs and morphological species identification were assessed.

Results

Taxonomy

Catoptria samnitica sp. nov.

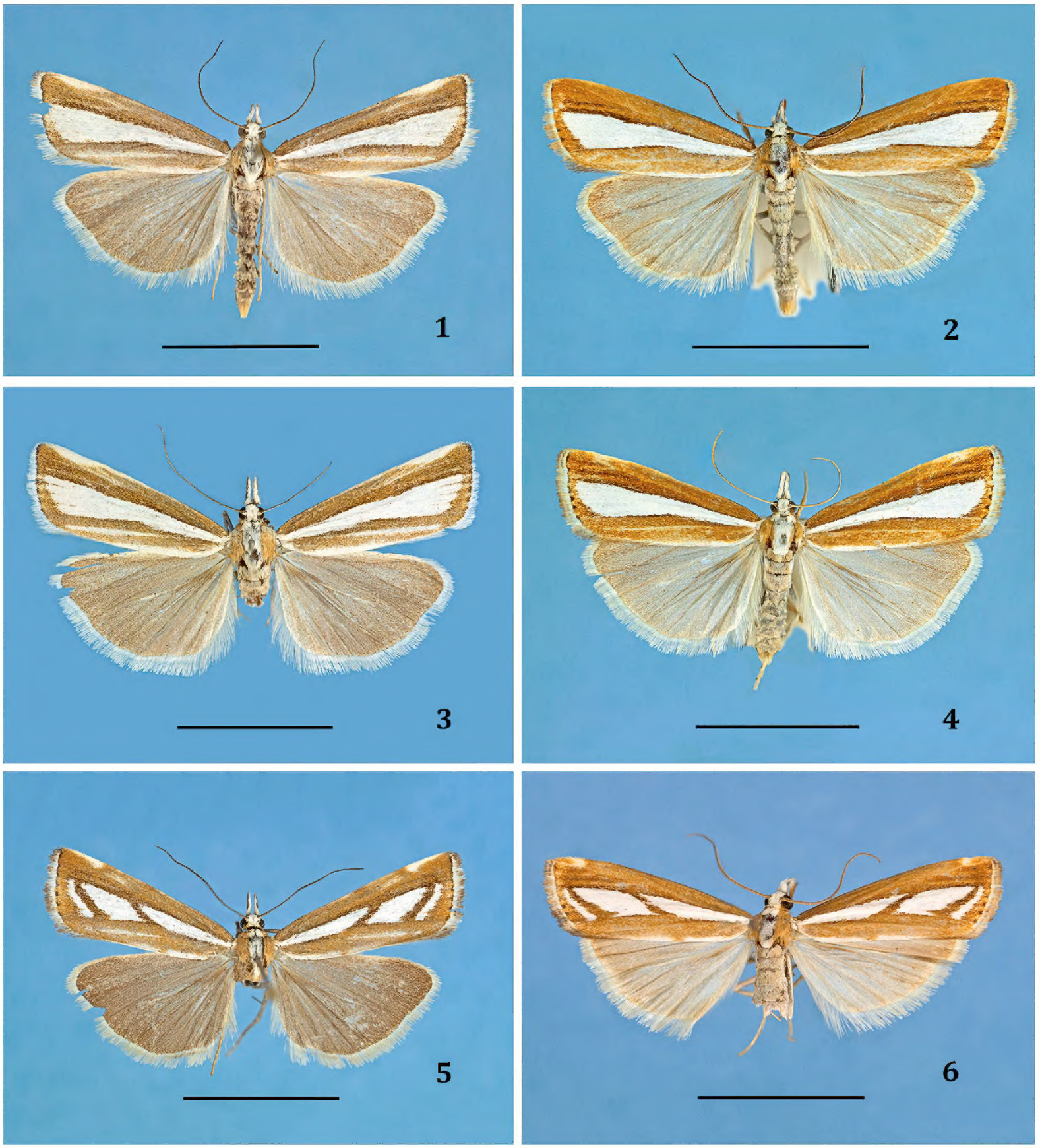
http://zoobank.org/2D684E5E-728D-45B3-BFFF-FF5F497C07B0

Type material. Holotype male: "Italien, Abruzzen / NP [National Park, Parco Nazionale del] Gran Sasso / ex Miniera di Lignite / 1750 m / 42°55,6′N, 13°42,8′E / 14.7.2010 / Mayr Toni leg.[it]" (TLMF).

Paratypes: 5 males, 8 females, Italia, Prov.[incia] l'Aquila, NP [National Park, Parco Nazionale del] Gran Sasso, ex Miniera di Lignite, 42°25'6"N, 13°42'8"E, 1750 m, 14–15.vii.2010, leg[it] Huemer, TLMF 2010-020, BC TLMF Lep 01573, BC TLMF Lep 01575, genitalia slides 6251, 6265, 6266 and 6292 GB; 6 males, 9 females, same data as holotype, genitalia slides 5750 and 5751 GB; 5 males, 3 females, same data, but 15.vii.2010 (TLMF, RCGB, RCTM).

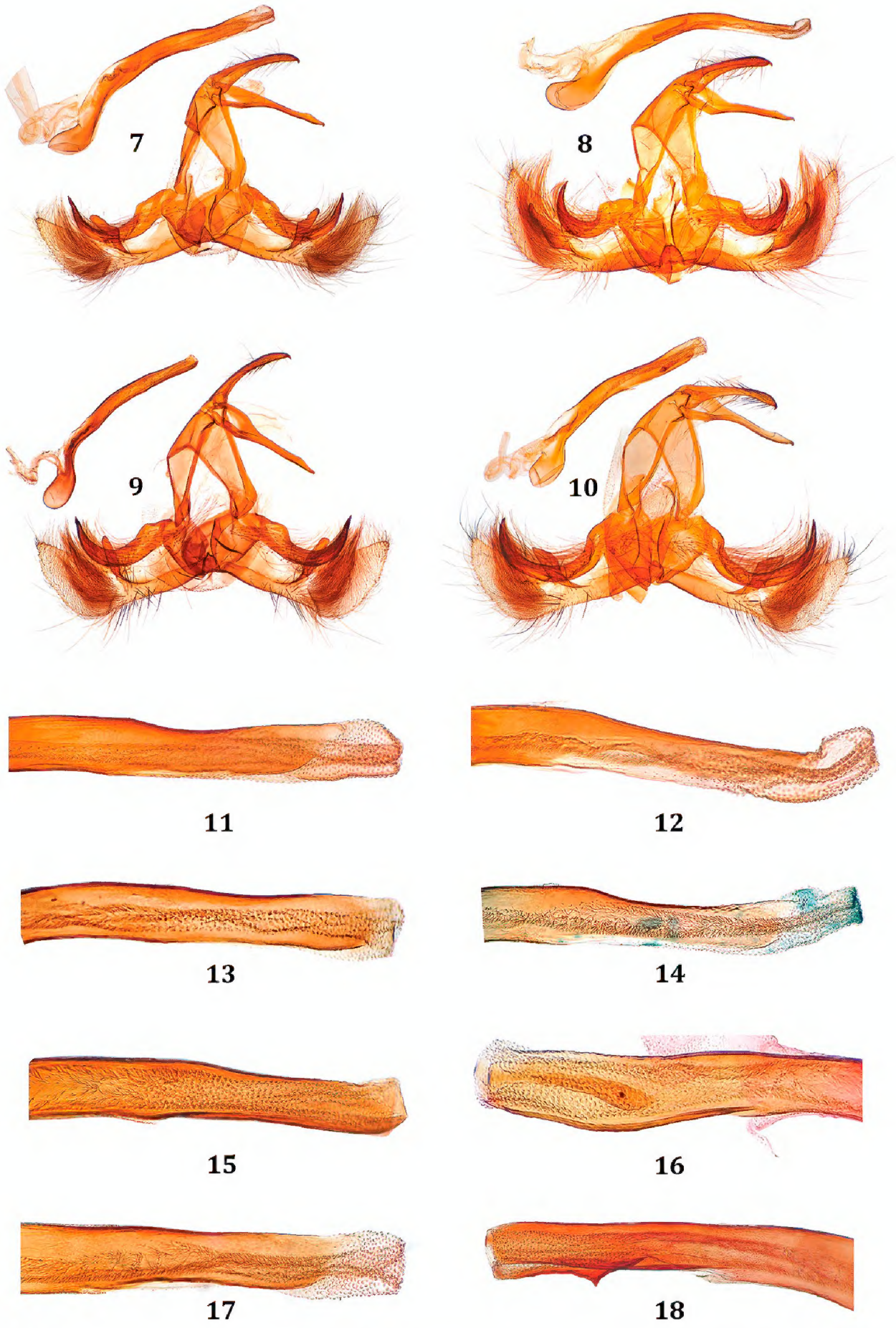
Etymology. The species name is derived from the ancient Latin region established by Rome's Emperor Augustus, the Regio IV, dubbed Samnium, which included Mt. Gran Sasso.

Diagnosis. *Catoptria samnitica* is similar in habitus (Figs 1, 3) to *C. spatulellus* (Figs 2, 4) in having a uniform white streak in the forewing, but the ground colour appears grey brown and the forewing markings include a large white costal subapical area and a narrow white subdorsal streak. The male genitalia (Figs 7, 11, 13), considering the species with a uniform streak, are similar to those of *C. spatulellus* (Figs 8, 12, 14), differing in the less upcurved basal process of the costa, in the slightly less developed medial process of the valva and in the

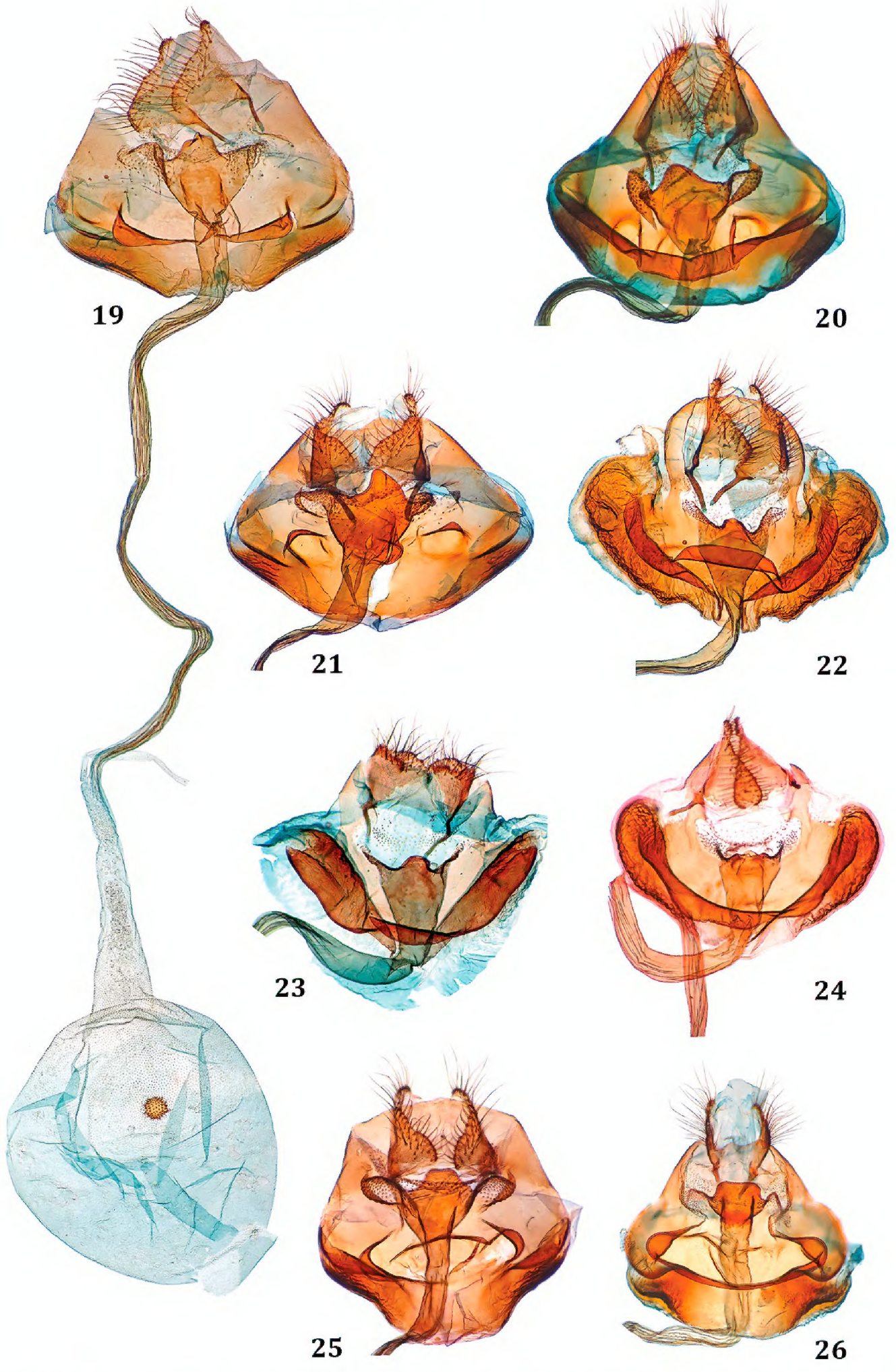


Figures 1–6. *Catoptria* spp., habitus **1** *C. samnitica* sp. nov., male paratype **2** *C. spatulellus* (Turati), male, Italy, Emilia, Pievepelago **3** *C. samnitica* sp. nov., female paratype **4** *C. spatulellus* (Turati), male, Italy, Emilia, Pievepelago **5** *C. apenninica* Bassi, male, Italy, Latium, Monte Terminillo **6** *C. europaeica* Błeszyński, male, Italy, Piedmont, Susa Valley, Giaglione. Scale bars: 10 mm.

phallus being more strongly sclerotized distally. In the female genitalia (Figs 19–21), both the large shape of the lamella antevaginalis of the sterigma and abdominal sternite VIII distinguish the new species from *C. spatulellus* (Figs 22–24). *Catoptria spatulelloides*, endemic to the Southern Apennines, is also similar in habitus to *C. samnitica*, but its genitalia (Bassi 1999: figs 15, 16) place it closer to *C. casperella* Ganev, 1983 and *C. myella* (Hübner, 1796). DNA



Figures 7–18. *Catoptria* spp., male genitalia **7** *C. samnitica* sp. nov., paratype, GS 6266 GB **8** *C. spatulellus* (Turati), Italy, Emilia, Pievepelago, GS 6225 GB **9** *C. apenninica* Bassi, Italy, Latium, Monte Terminillo, GS 6606 GB **10** *C. europaeica* Błeszyński, France, Alpes Maritimes, PN Mercantour, Col de la Moutière, GS 6257 GB **11** *C. samnitica* sp. nov., paratype, apex of phallus, GS 6266 GB **12** *C. spatulellus* (Turati), apex of phallus, Italy, Emilia, Pievepelago, GS 6225 GB **13** *C. samnitica* sp. nov., paratype, apex of phallus, GS 5750 GB **14** *C. spatulellus* (Turati), apex of phallus, Italy, Emilia, Pievepelago, GS 2954 GB **15** *C. apenninica* Bassi, apex of phallus, Italy, Latium, Monte Terminillo, GS 6606 GB **16** *C. europaeica* Błeszyński, apex of phallus, lateral, Italy, Piedmont, Vinadio, GS 2269 GB **17** *C. apenninica* Bassi, apex of phallus, Italy, Latium, Monte Terminillo, GS 6260 GB **18** *C. europaeica* Błeszyński, apex of phallus, dorsal, Italy, Piedmont, Susa Valley, Giaglione, GS 0080 GB. Not to scale.



Figures 19–26. *Catoptria* spp., female genitalia **19** *C. samnitica* sp. nov., paratype, GS 5751 GB **20** *C. samnitica* sp. nov., paratype, GS 6265 GB **21** *C. samnitica* sp. nov., paratype, GS 6292 GB **22** *C. spatulellus* (Turati), Italy, Emilia, Pievepelago, GS 6227 GB **23** *C. spatulellus* (Turati), Italy, Emilia, Gabellina, GS 2339 GB **24** *C. spatulellus* (Turati), Italy, Tuscany, Corfino, GS 6692 GB **25** *C. apenninica* Bassi, Italy, Latium, Monte Terminillo, GS 6669 GB **26** *C. europaeica* Błeszyński, France, Alpes Maritimes, PN Mercantour, Col de la Moutière, GS 6653 GB. Not to scale.

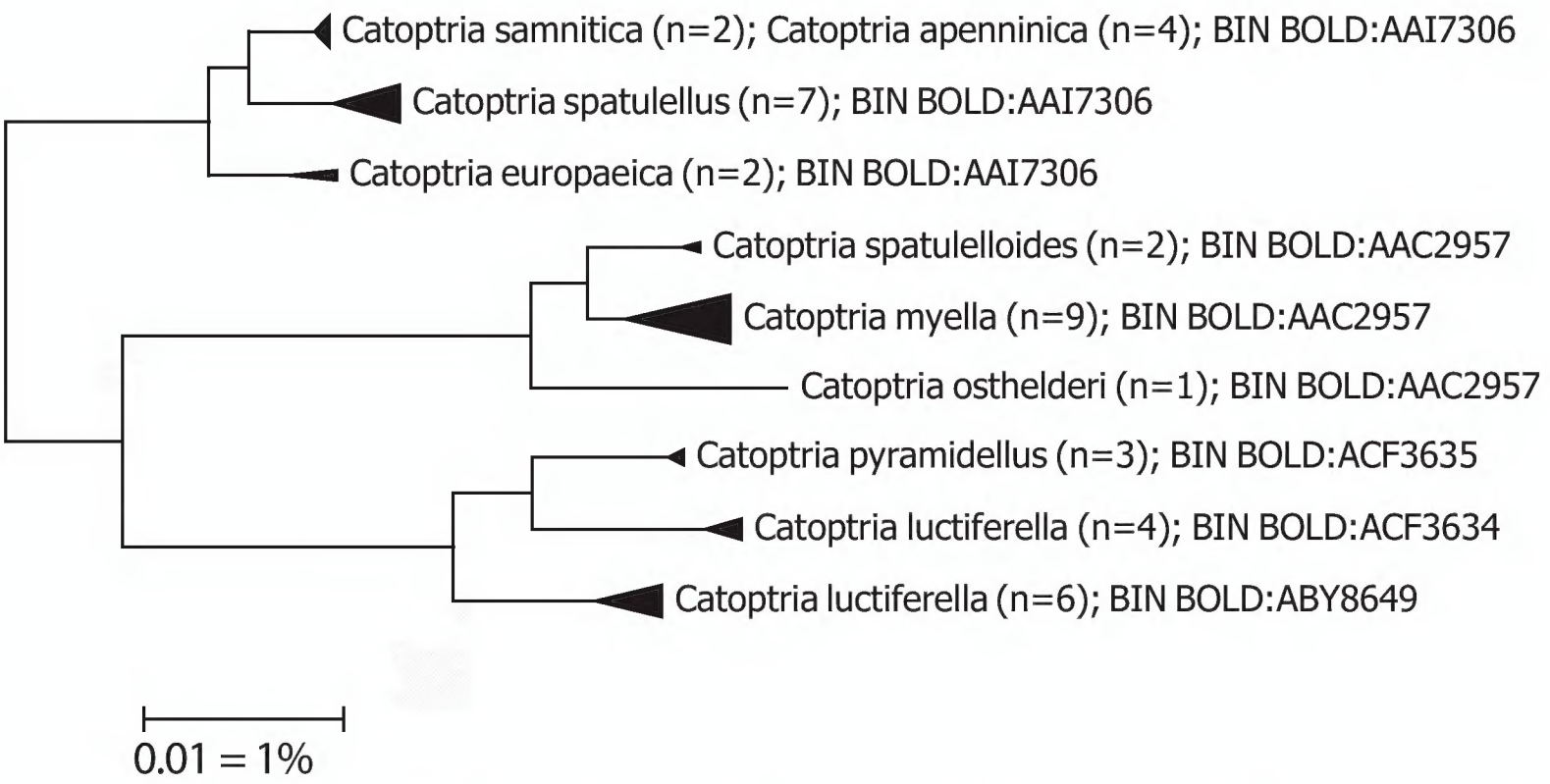

Catoptria samnitica (n=2); Catoptria apenninica (n=4); BIN BOLD:AAI7306
Catoptria spatulellus (n=7); BIN BOLD:AAI7306
Catoptria europaeica (n=2); BIN BOLD:AAI7306
Catoptria spatulelloides (n=2); BIN BOLD:AAC2957
Catoptria myella (n=9); BIN BOLD:AAC2957
Catoptria osthelderi (n=1); BIN BOLD:AAC2957
Catoptria pyramidellus (n=3); BIN BOLD:ACF3635
Catoptria luctiferella (n=4); BIN BOLD:ACF3634
Catoptria luctiferella (n=6); BIN BOLD:ABY8649
0.01 = 1%

Figure 27. Neighbor-Joining tree (Kimura 2 parameter, built with MEGA 6; cf. Tamura et al. 2013) of species of the *Catoptria permutatella* species group from Italy. The width of the triangles represents the sample size, and the depth the genetic variation within the cluster. Source: DNA Barcode data from BOLD (Barcode of Life Database, cf. Ratnasingham and Hebert 2007).

barcodes are shared with *C. apenninica*, a species with which it cannot be confused based on external morphology.

Description (Figs 1, 3). Wingspan: 23–26 mm, the female slightly larger than the male on average. Labial palpi 3 times longer than widest diameter of eye, white, outer edge bronze brown. Maxillary palpi basally bronze brown, then white. Antennae thickened in male, simple in female, grey brown with bright brown costa and first segment partially white. Frons subconical, slightly produced, white. Ocelli and chaetosemata well developed. Head white. Patagia medially white, laterally brown. Tegulae brown. Thorax white. Forewing ground colour grey brown; costa brown with a rather large subapical white dot; longitudinal streak white, distally enlarging and edged dark brown; narrow streak along 1a+2a vein white; terminal line dark brown; fringes white, grey brown at apex in male; female on average paler than male; underside bronze brown in male, bronze brown with costa and dorsum white in female. Hindwing brown with scattered white scales, especially basally at origin of M2–M3; fringes white; underside white suffused with brown, veins brown. Legs with inner edge bright yellow brown and outer edge white; spurs black; pairs of tibial spurs of different length. Abdomen bright yellow brown.

Male genitalia (Figs 7, 11, 13). Uncus narrow, apically downcurved and pointed; gnathos 1.2× length of uncus, with triangular and hooked apex; tegumen subrectangular; juxta subtriangular; vinculum stout, subrectangular; pseudosaccus well developed; valva slender, distally triangular, with medial process 0.3× length of valva, enlarging distally; costa with strongly pointed and upcurved basal process; phallus longer than valva, medially arched, apically sclerotized; vesica with several spinulae and scobinations.

Female genitalia (Figs 19–21). Papillae anales subtriangular, with sclerotized section narrowing dorsally. Apophyses posteriores subtriangular, rather short. Apophyses anteriores absent. Abdominal segment VIII large, sclerotized, with sternite strongly modified especially in the large basis and

medially. Ostium bursae opening inside sterigma, subtriangular, produced. Ductus bursae more than twice as long as corpus bursae, sinuous, sclerotized up to 0.75 of its length, then enlarging, membranous and distally scobinate. Ductus seminalis branching at 0.75 the length of ductus bursae. Corpus bursae suboval, scobinate and with rounded signum.

Biology. Host-plant and early stages unknown. The adults were attracted to artificial light during the night in a dry rivulet bed with xeromontane vegetation (Fig. 28).

Catoptria apenninica Bassi, 2017

Catoptria apenninica Bassi, 2017: 55–57

Material examined. 5 males, 1 female, Italia centr.[ale], Prov.[incia] Rieti, Monte Terminillo, 42°29'0"N, 13°00'6"E, 1730–1780 m, 12.vii.2010, leg[it] Huemer, TLMF 2010-020, BC TLMF Lep 01470, BC TLMF Lep 01471, genitalia slide 6250 GB; 2 males, 6 females, Italia centr.[ale], Prov.[incia] Rieti, Monte Terminillo, 42°29'0"N, 13°00'6"E, 1730–1780 m, 16.vii.2010, leg[it] Huemer, TLMF 2010-020, BC TLMF Lep 01656, BC TLMF Lep 01657, genitalia slide 6250 GB; 5 males, 5 females, Italia centr.[ale], Prov.[incia] Rieti, Monte Terminillo Nordhang [North slope], 42°29'0"N, 13°00'6"E, 1800 m, 18.vii.2011, leg.[it] Huemer, TLMF 2012-010, genitalia slides 6669, 6675 and 6693 GB; 2 males, 2 females, Italia centr.[ale], Prov.[incia] Rieti, Monte Terminillo Nordhang [North slope], 42°29'0"N, 13°00'6"E, 1800 m, 19.vii.2011, leg[it] Huemer, TLMF 2012-010; 2 males, Italien, Abruzzen [Lazio], Monte Terminillo, 1730 m, 42°29'0"N, 13°00'6"E, 17.vii.2010, Mayr Toni leg.[it], GS 6260 and 6606 (TLMF, RCGB, RCTM).

Diagnosis. See Bassi (2017: 55); Fig. 25 shows female genitalia variation compared with the holotype (Bassi 2017: fig. 3) and with *C. europaeica* Błeszyński 1965 (Fig. 26). Like the females the males are also smaller (on average 25–26 mm) than those of *C. europaeica* (on average 28–30 mm). In the forewing the medial band of the longitudinal streak is darker and slightly larger, along the costa the subapical dot is larger and extending closer to the apex, and the fringes are white, tipped brown as opposed to white with medial and apical grey brown bands in *C. europaeica*. The hind wing is brown as opposed to pale grey brown in *C. europaeica*. In the male genitalia (Figs 9, 15, 17) the phallus lacks the subapical tooth typical of *C. europaeica* (Figs 10, 16, 18).

Description of the male (Fig. 5). Wingspan 25 mm. Labial palpi 3 times longer than widest diameter of eye, white, outer edge bronze brown. Maxillary palpi basally bronze brown, then white. Antennae thickened, brown with bronze brown costa and first segment dorsally white. Frons subconical, slightly produced, white. Ocelli and chaetosemata well developed. Head white, bright brown around chaetosemata. Patagia medially white, laterally brown. Tegulae brown. Thorax white bordered brown. Forewing ground colour brown; costa brown with large subapical white streak; longitudinal streak white, distally enlarged and edged black brown; medial band distally widening, postmedial band equal in width; narrow streak along 1a+2a vein white; dorsum white basally; terminal line dark brown with four black dots; fringes white, tipped brown; underside bronze brown with costa paler. Hindwing brown; fringes white; underside brown. Legs with inner edge white and outer edge pale bronze brown; claws black; pairs of tibial spurs of different length, the distal smaller than proximal. Abdomen bright brown with anal tuft yellow brown.

Male genitalia (Figs 9, 15, 17). Uncus narrow, apically downcurved and pointed; gnathos clearly longer than uncus, with triangular and hooked apex; tegumen subrectangular, shorter than valva; juxta subtriangular, basally enlarged; vinculum stout, subrectangular; pseudosaccus well developed; valva slender, distally triangular, with medial process flat, long and slender; costa with strongly

Figure 28. Habitat of *Catoptria samnitica* (Gran Sasso, Italy).

Figuer 29. Habitat of *Catoptria apenninica* (Monte Terminillo, Italy).

pointed and upcurved basal process, shorter than valva; phallus longer than valva, medially arched, apically sclerotized along lower edge; vesica with several spinulae and scobinations.

Biology. Host-plant and early stages unknown. The holotype was collected in the daytime in cloudy weather conditions, whereas the vast majority of the specimens was attracted to artificial light in a xeromontane habitat (Fig. 29).

Remarks. The female holotype of *C. apenninica* was collected about 100 km south of the population at Monte Terminillo. The species appears to be an endemic of the Central Italian mountains, with the northern and southern limits of its distribution still to be fully investigated.

Molecular analysis

Forty specimens of the *Catoptria permutatella* species group from Italy, belonging to nine species, were successfully sequenced (sequence length 559 to 658 bp). Interspecific distances are generally very low in Italian species of the *C. permutatella* complex, ranging from a minimum of 0% to a maximum of 1.74% (mean 0.96%), whereas intraspecific divergence is sometimes much higher, e.g. in *C. luctiferella* (Hübner, [1813]) with a maximum intraspecific divergence of 2.82% (Table 1, Fig. 27).

Catoptria samnitica shares its DNA barcode with *C. apenninica*, a species occurring in the same region but different in forewing pattern and in genitalia morphology. Interestingly, a similar situation is found in the congeneric *C. pyramidellus* (Treitschke, 1832) and *C. speculalis* (Hübner, 1825) (Huemer and Hebert 2015, 2016). In the face of this partial conflict between morphology and mitochondrial data, inclusion of nuclear data should be investigated in the framework of a larger study on this problem. The phenomenon of barcode sharing is generally rare and reported for closely related species in Lepidoptera (Hausmann et al. 2013; Huemer et al. 2014), and often suspected to reflect taxonomic oversplitting (Mutanen et al. 2016). Similarly, BINs only partially reflect current species concepts with two BIN sharing clusters of 4 and 2 species respectively: *C. samnitica*, *C. apenninica*, *C. spatulella*, *C. europaeica*, and *C. spatulelloides*, *C. myella*. In contrast *C. luctiferella* splits into two BINs which cluster with *C. pyramidellus* and need further analysis (Fig. 27).

However, it was already previously documented that DNA barcodes fail to discriminate several morphologically well separated species in the genus *Catoptria* (Huemer and Hebert 2015, 2016), indicating a possible gene flow between different taxa, and these conclusions are supported by our current study.

Table 1. Intraspecific mean K2P (Kimura 2 Parameter) divergences, maximum pairwise distances and distance to nearest neighbour in almost all Italian species of the *Catoptria permutatella* species group.

Species	Mean Intra-Sp	Max Intra-Sp	Nearest Species	Nearest neighbour	Distance to NN
Catoptria samnitica	0	0	*Catoptria apenninica*	PHLAB670-10	0
Catoptria europaeica	0.48	0.48	*Catoptria apenninica*	PHLAB670-10	1.08
Catoptria apenninica	0.08	0.15	*Catoptria samnitica*	PHLAB774-10	0
Catoptria luctiferella	1.33	2.82	*Catoptria pyramidellus*	PHLAC037-10	1.55
Catoptria myella	0.6	1.24	*Catoptria spatulelloides*	LEASV335-19	0.92
Catoptria osthelderi (De Lattin, 1950)	N/A	0	*Catoptria spatulelloides*	LEASV334-19	1.74
Catoptria pyramidellus	0.1	0.15	*Catoptria luctiferella*	LEATE400-13	1.55
Catoptria spatulelloides	0.18	0.18	*Catoptria myella*	LEATE674-13	0.92
Catoptria spatulellus	0.47	0.84	*Catoptria apenninica*	PHLAB670-10	0.86

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